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MODIS Instrument Status and Operational Activities

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ABSTRACT

The Terra MODIS and Aqua MODIS have been successfully operated on-orbit for a total of more than six and a half years, collecting data for the science and applications communities to develop and enhance their understanding of the Earth/atmosphere system and to support studies of the climate and climate changes. Since its launch in December 1999, the Terra MODIS has experienced several changes of its operational configuration either caused by the failure of individual electronics subsystems or purposely switched for better signal response or data quality. Excluding minor anomalies related to instrument reset events during initial on-orbit operation, the Aqua MODIS has been operating in a single configuration since its launch in May 2002. There are approximately 40 science products that are being produced using the calibrated data sets from each instrument. In addition, several products are generated using the combined observations from both instruments. This paper provides an overview of Terra and Aqua MODIS instrument status and summarizes those on-orbit operational activities designed and implemented to provide and support instrument calibration and characterization. The assessments of instrument performance are based on the use of on-board calibrators (OBC) and other activities specially developed and implemented by the MODIS Characterization Support Team (MCST) at NASA/GSFC. Both instruments are performing well. During four and a half years of Terra MODIS on-orbit operation, 11 detectors became noisy and one inoperable out of a total of 490 detectors. Except for band 6 at 1.6 μ that had many inoperable detectors (identified pre-launch and immediately after launch), there have been no new noisy or inoperable detectors in Aqua MODIS during its two years of on-orbit operation. The sensors' spectral and spatial performance have also been very stable.

Keywords: MODIS, EOS Terra, EOS Aqua, radiometer, calibration, spectral and spatial characterization

1. INTRODUCTION

The Moderate Resolution Imaging Spectroradiometer (MODIS) Protoflight Model (PFM) has operated on-board the NASA's Earth Observing System (EOS) Terra spacecraft (originally EOS-AM) for more than four and a half years since its launch in December 1999. The MODIS Flight Model 1 (FM1), launched on-board the EOS Aqua spacecraft (originally EOS-PM) in May 2002, has operated on-orbit for more than two years. Both the Terra and Aqua spacecraft are in a Sun-synchronous near polar orbit at an altitude of 705km with Terra crossing the equator at 10:30 AM (descending southwards) and Aqua crossing the equator at 1:30 PM (ascending northwards). With improved spectral, spatial, and temporal resolutions over their heritage sensors, the Terra and Aqua MODIS missions have enabled data collection with complementary morning and afternoon observations and provided scientists enhanced capability for monitoring both short- and long-term environmental and climate changes, regionally and globally.

Both the Terra and Aqua MODIS instruments have 36 spectral bands each with wavelengths ranging from 0.41 to 14.5 μ m. There are two 250m nadir spatial resolution bands (1-2) with 40 along track detectors each, five 500m nadir spatial resolution bands (3-7) with 20 along track detectors each, and 29 1km nadir spatial resolution bands (8-36) with 10 along track detectors each. Multiple sub-samples are collected for the sub-kilometer resolution bands. Spectral bands 13 and 14 make observations with both high and low gains through time-delay and integration (TDI) using a pair of detector arrays. The 36 bands, with a total of 490 detectors, are located according to their spectral wavelengths on four focal plane assemblies (FPAs): visible (VIS), near infrared (NIR), short- and mid-wave infrared (SMIR), and long-wave infrared (LWIR). Bands 1-19 and 26 are reflective solar bands (RSB) with a total of 330 detectors and bands 20-25 and 27-36 are thermal emissive bands (TEB) with a total of 160 detectors. The MODIS is a scanning radiometer with a two-sided scan mirror, making observations over a wide field-of-view (FOV) of $\pm 55^\circ$ about nadir. To evaluate calibration accuracy and data quality, both instruments went through extensive pre-launch radiometric, spatial, and spectral calibration and characterization activities, including characterization of the sensors' response versus scan angle (RVS) and polarization sensitivity (RSB only)1.

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